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Original Study

Elevated Hospitalization Risk of Assisted Living Residents With Dementia in Alberta, Canada

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A B S T R A C T

Objectives: Assisted living (AL) is an increasingly used residential option for older adults with dementia; however, lower staffing rates and service availability raise concerns that such residents may be at increased risk for adverse outcomes. Our objectives were to determine the incidence of hospitalization over 1 year for dementia residents of designated AL (DAL) facilities, compared with long-term care (LTC) facilities, and identify resident- and facility-level predictors of hospitalization among DAL residents.

Methods: Participants were 609 DAL (mean age 85.7 ± 6.6 years) and 691 LTC (86.4 ± 6.9 years) residents with dementia enrolled in the Alberta Continuing Care Epidemiological Studies. Research nurses completed a standardized comprehensive assessment of residents and interviewed family caregivers at baseline (2006–2008) and 1 year later. Standardized administrator interviews provided facility level data. Hospitalization was determined via linkage with the provincial Inpatient Discharge Abstract Database. Multivariable Cox proportional hazards models were used to identify predictors of hospitalization.

Results: The cumulative annual incidence of hospitalization was 38.6% (34.5%–42.7%) for DAL and 10.3% (8.0%–12.6%) for LTC residents with dementia. A significantly increased risk for hospitalization was observed for DAL residents aged 90+ years, with poor social relationships, less severe cognitive impairment, greater health instability, fatigue, high medication use (11+ medications), and 2+ hospitalizations in the preceding year. Residents from DAL facilities with a smaller number of spaces, no chain affiliation, and from specific health regions showed a higher risk of hospitalization.

Conclusions: DAL residents with dementia had a hospitalization rate almost 4-fold higher than LTC residents with dementia. Our findings raise questions about the ability of some AL facilities to adequately address the needs of cognitively impaired residents and highlight potential clinical, social, and policy areas for targeted interventions to reduce hospitalization risk.

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The increasing number of older adults with dementing disorders[1–4] presents significant challenges to providers and policy makers striving to ensure cost-effective, high quality care for aging populations. Similar to trends observed in the US,[5–11] older adults with dementia, often with significant comorbidity, are increasingly being cared for in assisted living (AL) settings within Canada.[12,13] Current estimates suggest that between 40% and 60% of AL residents across North America have a diagnosis of dementia.[5,9,12] The rapid expansion of AL over recent years reflects both the lower costs of this residential option compared with long-term (ie, nursing home) care (LTC) as well as individual preferences for more home-like settings.[14,15] Yet, the AL sector remains poorly defined and understood.[12,16] In particular, uncertainty persists regarding how best to structure and implement integrated care to support personal preferences while limiting costly and potentially inappropriate transitions in care.[17–19]

AL facilities aim to provide secure housing, personal support and limited health care while promoting choice, autonomy, privacy, and independence.[5,20] Although the specific role of AL varies considerably across regions, in many instances it is viewed as a substitute for long-term care.[12,15] Yet, the care philosophy and approach adopted by the AL sector (emphasizing a social care model with support services provided in a home-like residential setting) differ substantially from the traditional LTC setting.[12,15] Although it is acknowledged that the AL philosophy may promote functional independence and satisfaction among residents, many clinical and quality of care issues remain unanswered.[5,17] The lower staffing levels with predominantly nonprofessional care providers and limited availability of ancillary services within AL (relative to LTC) has raised concerns that more vulnerable residents may be at an increased risk for poor quality of care and adverse health outcomes.[9,17,21–23] Delayed detection of emerging health issues, suboptimal medication management, and limited ability to augment care in the AL setting could ultimately result in higher use of hospital care and costs.[16,23–27] These concerns are heightened for older residents with dementia who often exhibit considerable comorbidity, atypical disease presentation, and difficulties in communicating their symptoms and needs.[18,19,28]

Relative to LTC,[29–36] empirical data on the health and social needs and outcomes of older residents with dementia in AL remain scarce.[7–9,37] It is unclear whether observed differences in resident, facility, and system characteristics contribute to elevated risks for potentially adverse outcomes.[9,38–40] In the US Collaborative Studies for Long-Term Care,[9] adjusted analyses revealed a significantly higher 1-year hospitalization rate for residents with dementia in AL compared with LTC. Interestingly, no other outcome differences were observed across these 2 settings.[8,9,17] These findings illustrate the challenges faced by AL facilities in caring for cognitively vulnerable residents with substantial and often unstable medical and nursing needs.[9,21,26,37]

Hospitalization is an important outcome not only as a potential quality of care indicator for the AL sector but also in light of the health risks posed for older persons with dementia who experience an acute care admission. Community- and claims-based studies have consistently shown that relative to matched controls, those with dementia are significantly more likely to be hospitalized (often for potentially preventable reasons),[18,28,41] to have longer lengths of stay,[42,43] and higher health care costs.[41,44] These vulnerable patients are also at greater risk for experiencing poorer health and functional outcomes during and posthospitalization.[28,45–47] Given the increasing use of AL facilities and the relative absence of data on the extent and risk factors for hospitalization among older AL residents with dementia, further large-scale investigations are needed for more informed clinical and policy decisions.[17]

We sought to estimate the incidence of hospitalization among designated (publicly funded) assisted living (DAL) residents with dementia in Alberta over 1 year, to compare this rate to that observed among LTC residents with dementia from the same catchment areas and time period, and to identify DAL resident and facility characteristics associated with an increased risk for hospitalization.

Methods

Study Design

Data were derived from the Alberta Continuing Care Epidemiological Studies (ACCES), a longitudinal investigation of AL and LTC residents in the Province of Alberta, Canada.[20,48] The AL cohort included older residents of designated (publicly funded) AL and supportive housing facilities (DAL) in 5 health regions (2 major urban and 3 largely rural regions). At the time of the study, these regions accounted for over 80% of provincial continuing care beds. The DAL settings included in ACCES fell under the supportive living stream adopted by the province at this time and, thus, encompassed a philosophy and approach for providing support services within a secure housing and "home-like" environment. Although the settings shared similar features (including a focus on promoting resident independence, autonomy, privacy, and aging in place), there were some differences across the health regions in target populations, and in the type and availability of care staff and services.[12,20] Further details regarding the residents and facilities included in ACCES have been published elsewhere.[12,20,48]

To be eligible for inclusion, DAL facilities had to be in operation for 6+ months; not primarily serving residents with mental illness (other than dementia) or developmental disabilities; and, housing a minimum number of DAL residents 65+ years old ($\geq$4 for small and $\geq$10 for large facilities). Fifty-nine of the 60 DAL facilities meeting these criteria agreed to participate. Residents in participating DAL sites were excluded if they were aged less than 65 years, recently admitted ($<$21 days), receiving palliative care (expected survival $<$6 months), and/or their participation was otherwise deemed inappropriate by staff or family. A total of 1089 participants of the 1510 eligible residents (72.1% response rate) were enrolled and assessed [339 (22.5%) refused and for 82 (5.4%) their legally designated surrogate could not be contacted]. Age and sex were available for 364/421 (86.5%) of the nonparticipants and showed a similar distribution (mean age 84.4 $\pm$ 7.1, 74% women) to those enrolled. Of the 1066 residents with outcome measures (excluded were 3 residents with unknown outcomes and 20 who refused consent for administrative data linkage), there were 609 (57.1%) with a recorded diagnosis of dementia.

A random sample of small and large LTC facilities (based on median bed number) was selected in each region employing the same facility eligibility criteria. Within Alberta, LTC facilities provide support and 24-hour registered nursing care (including on an unscheduled basis) for persons with complex and chronic health needs. At the time of the study, these facilities did not provide short-stay or post-acute care or intravenous therapy. As such, residents are comparable to the long-stay nursing home population in the United States. Fifty-four of the 59 facilities approached agreed to participate. A random sample of 1731 eligible residents (same resident criteria) in the participating facilities was approached, and 1000 were enrolled and assessed (57.8% response rate). Age and sex were available for 665/731 (91%) of nonparticipants and showed a similar distribution (mean age 84.7 $\pm$ 7.5, 67% women) to participants. Of the 976 LTC participants with outcome measures (3 could not be linked with administrative data and 21 did not consent to data linkage), 691 (70.8%) had a recorded diagnosis of dementia.

Ethics approval was obtained from the University of Calgary Conjoint Health Research Ethics Board, the University of Alberta

Health Research Ethics Board and the University of Lethbridge Human Subject Research Committee.

Resident Level Characteristics

At baseline (2006–2008), trained research nurses administered the Resident Assessment Instrument for Assisted Living or LTC Facility (interRAI-AL or interRAI-LTC Facility) among DAL and LTC residents, respectively. These validated instruments provide a comprehensive, standardized assessment of residents' sociodemographic characteristics, physical and cognitive status, health conditions, behavioral problems, and use of medications and services.[49,50]

Resident characteristics examined included age, sex, marital status, length of stay, social engagement, cognitive and functional status, depressive symptoms, health stability, fatigue (defined as inability to complete normal daily activities in past 3 days), aggressive behaviors, number of chronic diseases and medications [including hyperpolypharmacy[27] (11+ medications) and use of a cholinesterase inhibitor and/or memantine], falls, previous hospitalizations (past year), bladder and/or bowel incontinence, and presence of advanced directives. Residents' functional and health characteristics were captured by validated scales derived from assessment items on the interRAI tools, including the: Cognitive Performance Scale (CPS)[51]; Activities of Daily Living Self-Performance Hierarchy Scale[52]; Depression Rating Scale[53]; Changes in Health, End-Stage Disease and Symptoms and Signs Scale (for health instability)[54]; and, Aggressive Behavior Scale.[55] Higher scores on all scales indicate more severe impairment. Comorbidity was measured by the sum of recorded diagnoses on the interRAI instruments. A total of 48 possible diagnoses (in addition to dementia) were considered in this comorbidity score. All diagnoses (including that of dementia, which was used to define our study cohorts), recorded on the interRAI assessment were considered present if indicated (in the chart) as the main reason for the current stay or if assessed by care providers as relevant to the resident's current functional and cognitive status, treatment and monitoring needs, or risk of decline in health status. Previous research has shown relatively high sensitivity estimates (of 0.80 or greater) for several recorded diagnoses on the RAI tools (including dementia) when compared with acute care discharge abstracts.[56] Social engagement was assessed by 2 measures calculated from items on the instruments: (1) strength of social relationships; and, (2) average time involved in activities when awake and not receiving treatments or activities of daily living assistance.

Facility Level Characteristics

Facility administrators, managers or directors of care (ie, someone familiar with the facility with direct knowledge about the residents) were surveyed approximately midway during follow-up. Facility characteristics examined included: location (health region; community size), ownership (for-profit vs not; whether part of a multifacility system or chain of facilities), year spaces opened, availability of other levels of care on site including LTC and acute care, presence of dementia beds (may or may not include specialized care), type and size of facility (number of spaces and total facility spaces), and staffing levels and oversight [24 hour/7 day availability of licensed practical and/or registered nurses (LPNs/RNs) on site; physician involvement/affiliation with site].

Outcomes

The primary outcome was time to first acute care hospitalization within a year of baseline assessment. This was determined via linkage with the Alberta Inpatient Discharge Abstract Database. The date of admission, most responsible diagnosis (based on International Classification of Diseases, 10th Revision, Canadian codes),[57] length of stay (LOS), and alternate level of care (ALC) bed-days (ie, occupying a hospital bed when not requiring the intensity of resources/services provided in this care setting) were examined. An ALC designation means that a medical decision has been made that the patient does not require further acute care services and should be discharged. A patient designated ALC and remaining in hospital is an individual that cannot be discharged because adequate care is not available elsewhere.[43] We assessed the first discharge event associated with an admission to acute care rather than total hospitalizations as the latter may include hospitalization occurring after a move from the original setting and may reflect characteristics of the new location. This approach captured nearly all residents hospitalized [90.2% (220/244) of DAL and 94.9% (74/78) of LTC residents] during follow-up. Detailed information on other transitions was obtained from facility discharge tracking forms (provided at the time of transfer or death), family caregiver discharge/decedent interviews (performed around the time of transfer or death), and family caregiver interviews at 1-year follow-up (assessing all moves from baseline).

Analysis

Descriptive analyses examined the distribution of DAL resident and facility characteristics overall and by outcome status. Incidence of hospitalization was derived for DAL and LTC cohorts accounting for the occurrence of death as a competing risk using Cumulative Incidence Competing Risk curves.[58]

Multivariable Cox proportional hazards models,[59,60] adjusted for clustering of residents within facilities, were used to examine the relative importance of resident and facility characteristics as predictors of time to first acute care hospitalization for the DAL cohort. Residents were classified into discrete outcome groups according to the date of their first event (ie, inpatient hospitalization, LTC admission or death without prior hospitalization, other transitions without prior hospitalization, no event and remained in DAL throughout the year). Residents were censored on the date of occurrence of LTC admission (DAL cohort), death, or discharge to some another setting. Those experiencing none of these events and remaining in DAL throughout the year were censored at their 1-year follow-up assessment date.

Baseline resident and facility characteristics examined as potential predictors of hospitalization were selected based on previous literature.[9,31–40] Resident-level variables significant ($P < .05$) in age-adjusted analyses were entered one at a time and retained if they remained significant predictors ($P < .10$) in the full model. We then incorporated health region (fixed effect) and tested the significance of each of the facility-level variables entered separately. Because of relatively high correlations among facility characteristics, we examined separate models testing the effect of each facility variable adjusting for resident characteristics.[16,27]

Analyses were conducted using SAS software (Version 9.2) [SAS Institute Inc., Cary, NC, USA] and R (Version 2.13-1, R Development Core Team).

Results

DAL residents with dementia were typically older widowed women (mean age 85.7 ± 6.6 years, 73.2% widowed and 78% female). Mean number of diagnoses was 4.8 ± 2.0 (range 1–14) with hypertension (56.8%), arthritis (51.7%), depression (36.0%), osteoporosis (29.7%), and coronary heart disease (28.1%) the most common. On average, residents were on 7.7 (standard deviation 3.6) medications (range 0–23) with 42.7% receiving dementia pharmacotherapy

Table 1
Baseline Sociodemographic, Health, and Functional Characteristics of Residents by Outcome Event During 1-Year Follow-Up, ACCES-DAL Dementia Cohort (n = 609)

	Total Number (% of Total)	Outcome Number (% of Row Total)*,†			*P* value
		Hospitalization	LTC/Death	Still in DAL	
Overall	609	220 (36.1)	90 (14.8)	298 (48.9)	
Age					
Mean ± SD	85.7 ± 6.6	86.2 ± 6.0	86.5 ± 6.4	85.1 ± 7.0	.0836
65–79	123 (20.2)	39 (32.0)	15 (12.3)	68 (55.7)	.5150
80–85	177 (29.1)	66 (37.3)	24 (13.6)	87 (49.2)	
86–89	144 (23.7)	49 (34.0)	23 (16.0)	72 (50.0)	
90+	165 (27.1)	66 (40.0)	28 (17.0)	71 (43.0)	
Sex					.1957
Female	475 (78.0)	165 (34.7)	68 (14.3)	242 (51.0)	
Male	134 (22.0)	55 (41.4)	22 (16.5)	56 (42.1)	
Marital status					.5664
Widowed	446 (73.2)	160 (35.9)	66 (14.8)	220 (49.3)	
Married/partner	95 (15.6)	37 (39.0)	17 (17.9)	41 (43.2)	
Never married/separated/divorced	68 (11.2)	23 (34.3)	7 (10.5)	37 (55.2)	
Strength of social relationships†					.0033
Moderate/high (3–5)	484 (79.5)	166 (34.4)	64 (13.3)	253 (52.4)	
Low/none (0–2)	125 (20.5)	54 (43.2)	26 (20.8)	45 (36.0)	
Average time involved in activities§					.0076
Most (>2/3 time)	76 (12.5)	23 (30.7)	7 (9.3)	45 (60.0)	
Some (1/3 to 2/3 time)	229 (37.6)	81 (35.4)	25 (10.9)	123 (53.7)	
Little–none (<1/3 time)	304 (49.9)	116 (38.2)	58 (19.1)	130 (42.8)	
Cognition (CPS score)					
Intact (0)	34 (5.6)	16 (48.5)	4 (12.1)	13 (39.4)	.0016
Borderline intact (1)	63 (10.3)	16 (25.4)	5 (7.9)	42 (66.7)	
Mild impairment (2)	227 (37.3)	89 (39.2)	23 (10.1)	115 (50.7)	
Moderate-severe–very severe Impairment (3+)	285 (46.8)	99 (34.7)	58 (20.4)	128 (44.9)	
Activities of daily living (ADL score)					
Independent (0)	198 (32.5)	68 (34.5)	10 (5.1)	119 (60.4)	<.0001
Supervision required (1)	143 (23.5)	49 (34.3)	21 (14.7)	73 (51.1)	
Limited impairment (2)	84 (13.8)	26 (31.0)	14 (16.7)	44 (52.4)	
Extensive assistance required/dependent (3+)	184 (30.2)	77 (41.9)	45 (24.5)	62 (33.7)	
Health instability (CHESS score)‖					
Stable (0)	289 (47.5)	88 (30.6)	34 (11.8)	166 (57.6)	<.0001
Mild (1)	162 (26.6)	69 (42.6)	20 (12.4)	73 (45.1)	
Mild–moderate (2)	108 (17.7)	41 (38.0)	19 (17.6)	48 (44.4)	
Moderate–high (3+)	50 (8.2)	22 (44.0)	17 (34.0)	11 (22.0)	
Fatigue, <3 days					<.0001
None	278 (45.7)	86 (31.1)	32 (11.6)	159 (57.4)	
Minimal	236 (38.8)	92 (39.0)	32 (13.6)	112 (47.5)	
Moderate–severe	95 (15.6)	42 (44.2)	26 (27.4)	27 (28.4)	
Primary mode locomotion					
Walks independently	182 (29.9)	51 (28.2)	15 (8.3)	115 (63.5)	<.0001
Walks with assistive device	337 (55.3)	131 (38.9)	53 (15.7)	153 (45.4)	
Wheelchair/scooter¶	90 (14.8)	38 (42.2)	22 (24.4)	30 (33.3)	
Falls					
1+ falls/90 days	177 (29.1)	78 (44.1)	31 (17.5)	68 (38.4)	.0036
None	432 (70.9)	142 (33.0)	59 (13.7)	230 (53.4)	
Depressive symptoms (DRS score)					
Yes (3+)	140 (23.0)	51 (36.4)	29 (20.7)	60 (42.9)	.0577
No (<3)	469 (77.0)	169 (36.1)	61 (13.0)	238 (50.9)	
Aggressive behavior (ABS score)**					
None (0)	370 (60.8)	140 (37.8)	48 (13.0)	182 (49.2)	.5792
Moderate (1–2)	121 (19.9)	41 (34.2)	20 (16.7)	59 (49.2)	
Severe (3–5)	90 (14.8)	29 (32.2)	15 (16.7)	46 (51.1)	
Very severe (6+)	28 (4.6)	10 (35.7)	7 (25.0)	11 (39.3)	
Number of chronic conditions					
Mean ± SD	4.8 ± 2.0	5.1 ± 2.0	5.2 ± 2.2	4.5 ± 1.9	.0009
0–3	173 (28.4)	50 (29.1)	20 (11.6)	102 (59.3)	.0072
4–5	223 (36.6)	78 (35.0)	35 (15.7)	110 (49.3)	
6+	213 (35.0)	92 (43.2)	35 (16.4)	86 (40.4)	
Number of medications					
Mean ± SD	7.7 ± 3.6	8.4 ± 3.7	8.0 ± 3.5	7.1 ± 3.4	.0002
0–6	241 (39.6)	69 (28.8)	33 (13.8)	138 (57.5)	.0111
7–8	139 (22.8)	50 (36.0)	23 (16.6)	66 (47.5)	
9–10	115 (18.9)	46 (40.0)	17 (14.8)	52 (45.2)	
11+	114 (18.7)	55 (48.3)	17 (14.9)	42 (36.8)	
Dementia medications					.8701
Yes	260 (42.7)	91 (35.0)	39 (15.0)	130 (50.0)	
No	349 (57.3)	129 (37.1)	51 (14.7)	168 (48.3)	
Advanced directive –Do not hospitalize					.6976
Yes	63 (10.3)	21 (33.3)	8 (12.7)	34 (54.0)	
No	546 (89.7)	199 (36.5)	82 (15.1)	264 (48.4)	

(*continued on next page*)

Table 1 (*continued*)

	Total Number (% of Total)	Outcome Number (% of Row Total)*,†			*P* value
		Hospitalization	LTC/Death	Still in DAL	
Previous inpatient hospitalizations (past year)					<.0001
0	413 (67.8)	131 (31.8)	64 (15.5)	217 (52.7)	
1	138 (22.7)	54 (39.1)	16 (11.6)	68 (49.3)	
2+	58 (9.5)	35 (60.3)	10 (17.2)	13 (22.4)	
Bladder incontinence					
Continent	231 (37.9)	78 (33.9)	19 (8.3)	133 (57.8)	<.0001
Some control, infrequent episodes	83 (13.6)	35 (42.2)	8 (9.6)	40 (48.2)	
Occasional incontinence	60 (9.9)	20 (33.3)	8 (13.3)	32 (53.3)	
Frequent episodes, no control	235 (38.6)	87 (37.0)	55 (23.4)	93 (39.6)	
Bowel incontinence					
Continent	412 (67.7)	136 (33.1)	48 (11.7)	227 (55.2)	<.0001
Some control, infrequent episodes	99 (16.3)	46 (46.5)	15 (15.2)	38 (38.4)	
Occasional incontinence	56 (9.2)	21 (37.5)	14 (25.0)	21 (37.5)	
Frequent episodes, no control	42 (6.9)	17 (40.5)	13 (31.0)	12 (28.6)	

ABS, Aggressive Behavior Scale; ADL, Activities of Daily Living Self-Performance Hierarchy Scale; CHESS, Changes in Health, End-stage disease and Symptoms and Signs Scale; DAL, designated assisted living; DRS, Depression Rating Scale; SD, standard deviation.

*Except where indicated otherwise.

†One resident with other outcome (censored at date of first discharge from DAL) omitted from comparisons.

‡Social relationships variable was based on a summary score of items assessing whether resident was close to someone in the facility, had a strong/supportive relationship with family, participated in social activities of longstanding interest and visited or had other interactions with longstanding social relation/family member (in past week).

§Activity involvement reflected time when awake and not receiving treatments or ADL care.

||Two items (insufficient fluid, noticeable decline in food/fluid) that are usually used to calculate CHESS were not included on interRAI-Assisted Living tool.

¶Includes 1 resident who was bedbound.

**The ABS is a summary scale of 4 behaviors (verbal abuse, physical abuse, socially inappropriate, or disruptive, resists care) with higher scores indicating a greater number and frequency of behavioral issues.

[primarily donepezil, 162/260 (62.3%)]. Approximately one-tenth were reported to have a "Do Not Hospitalize" advance directive and one-third had been hospitalized at least once in the previous year. Almost two-thirds (n = 388) resided in a facility with an LPN and/or RN on site 24/7 and 42.2% (n = 257) in a facility with dementia beds. Please see Tables 1 and 2 for additional baseline information.

Relative to DAL, LTC residents with dementia were more likely to be male and married (Supplementary Appendix 1). They were also more likely to have weak social relationships, be less active, and have greater health issues, cognitive and functional impairments, mood and behavioral challenges, and comorbidity. The 2 cohorts were similar in the proportion with recent falls and high levels of medication use, although residents with dementia in LTC were significantly less likely (21.6%) than those in DAL (42.7%) to be receiving dementia pharmacotherapy. LTC residents were significantly less likely (21.8%) than DAL (32.2%) residents to have been admitted to hospital during the year prior to baseline. Nearly one-third of LTC residents were reported to have a "Do Not Hospitalize" directive. LTC facilities were more likely to have not-for-profit ownership, less likely to be part of a chain with AL and LTC sites, generally older with more beds, and universally had 24/7 LPN/RN coverage on site.

During the 1-year follow-up, 220 (36.1%) DAL residents with dementia experienced an acute care hospitalization as their first event. The proportion hospitalized did not differ between those with [21/63 (33.3%)] and without [199/546 (36.4%)] a "Do Not Hospitalize" advance directive. The hospitalization rate was 51.7 per 100 person-years. The cumulative incidence was 23.3% (95% CI 19.9–26.8) at 6 months and 38.6% (95% CI 34.5–42.7) at 12 months (Figure 1A). The median LOS for hospitalizations was 14 days (IQR 5–43 days). Total bed days were 6485. Sixty-four (29.1%) had 1 or more ALC bed-days (total ALC bed-days = 1391; median ALC length of stay 12.5, range 1–93, IQR 6.5–32.5). The total number of hospitalizations experienced by DAL residents with dementia during the 1-year follow-up was 319 (total bed days = 8553).

During the 1-year follow-up, 74 (10.7%) LTC residents with dementia experienced an acute care hospitalization as their first event with a rate of 13.1 per 100 person-years. LTC dementia residents with a "Do Not Hospitalize" directive were significantly less likely [14/225 (6.2%)]) than those without [60/466 (12.9%)] to be admitted to hospital ($P = .008$). The cumulative incidence of hospitalization was 5.9% (95% CI 4.2–7.7) at 6 months and 10.3% (95% CI 8.0–12.6) at 12 months (Figure 1B), significantly lower than that observed for DAL residents ($P < .001$). Median LOS for hospitalizations was 7 days (IQR 3–13 days) and total bed days were 717. Only 1 admission (1.4%) had any ALC bed-days (16 total ALC bed-days). The total number of hospitalizations experienced by LTC residents with dementia during the 1-year follow-up was 100 (total bed days = 1193).

For both sites, the common causes for hospitalization are described in Supplementary Appendix 2 and the corresponding Cumulative Incidence Competing Risk curves stratified by number of previous hospitalizations are presented in Supplementary Appendix 3.

In adjusted analyses, a significantly increased risk for hospitalization was observed for DAL dementia residents aged 90+ years, with poor social relationships, less severe cognitive impairment, moderate to severe fatigue, high medication use (11+ medications), and 2+ hospitalizations during the preceding year (Table 3). Residents with some health instability and those with bowel incontinence had a modestly increased risk. DAL residents from specific (primarily rural) health regions showed a higher risk of hospitalization. As community size was highly correlated with region it was not retained in the models.

In models adjusted for resident characteristics and health region, a significantly higher likelihood of hospitalization was observed for residents from DAL facilities that were smaller (<20 DAL spaces). Residents from facilities with no chain affiliation also showed an increased risk of hospitalization (Table 4). Given the increased hospitalization risk for residents within rural regions as well as findings showing these regions were significantly more likely to include DAL facilities that were small, not part of a chain and had neither a LPN nor RN on site, we examined separate models for each of our facility factors excluding health region. The results showed stronger estimates for the above facility factors [eg, adjusted hazard ratios of 2.30 (1.55–3.39) for residents of small facilities and 2.08 (1.18–3.64) for residents of facilities with no chain affiliation] as well as a significant hospitalization risk for resident of facilities with no LPN and/or RN on site [adjusted hazard ratio of 1.61 (1.16–2.24)].

Table 2
Baseline Care System and Facility Characteristics of Residents by Outcome Event During 1-Year Follow-Up, ACCES-DAL Dementia Cohort (n = 609)

	Total Number (% of Total)	Outcome Number (% of Row Total)*			*P* value
		Hospitalization	LTC/Death	Still in DAL	
Overall	609	220 (36.1)	90 (14.8)	298 (48.9)	
Region					
1 (urban)	166 (27.3)	49 (29.7)	23 (13.9)	93 (56.4)	.0182
2 (mixed urban/rural)	135 (22.2)	48 (35.6)	22 (16.3)	65 (48.2)	
3 (rural)	77 (12.6)	41 (53.3)	11 (14.3)	25 (32.5)	
4 (urban)	174 (28.6)	57 (32.8)	24 (13.8)	93 (53.5)	
5 (rural)	57 (9.4)	25 (43.9)	10 (17.5)	22 (38.6)	
Ownership					.0075
For-profit	233 (38.3)	67 (28.9)	34 (14.7)	131 (56.5)	
Not-for-profit/RHA	376 (61.7)	153 (40.7)	56 (14.9)	167 (44.4)	
Part of chain					
No/RHA operated	70 (11.5)	33 (47.1)	9 (12.9)	28 (40.0)	.0139
Yes − AL chain	181 (29.7)	67 (37.0)	16 (8.8)	98 (54.1)	
Yes − AL/LTC chain	358 (58.8)	120 (33.6)	65 (18.2)	172 (48.2)	
Year DAL spaces opened					
Before 2002	124 (20.4)	42 (33.9)	20 (16.1)	62 (50.0)	.9747
2002 or 2003	203 (33.3)	74 (36.6)	30 (14.9)	98 (48.5)	
2004 or later	282 (46.3)	104 (36.9)	40 (14.2)	138 (48.9)	
Number of DAL spaces					
<20	58 (9.5)	29 (50.0)	10 (17.2)	19 (32.8)	.0388
20–29	103 (16.9)	40 (38.8)	21 (20.4)	42 (40.8)	
30–39	147 (24.1)	48 (32.9)	19 (13.0)	79 (54.1)	
40+	301 (49.4)	103 (34.2)	40 (13.3)	158 (52.5)	
Number of total spaces					
<55	90 (14.8)	39 (43.3)	15 (16.7)	36 (40.0)	.3548
55–89	147 (24.1)	59 (40.1)	21 (14.3)	67 (45.6)	
90–147	138 (22.7)	42 (30.4)	21 (15.2)	75 (54.4)	
148+	234 (38.4)	80 (34.3)	33 (14.2)	120 (51.5)	
Levels of care on site†					.4266
DAL only/DAL+ Equivalent/lower	507 (83.3)	178 (35.2)	78 (15.4)	250 (49.4)	
DAL + higher level	102 (16.8)	42 (41.2)	12 (11.8)	48 (47.1)	
Dementia beds on site					.0071
Yes	257 (42.2)	82 (31.9)	42 (16.3)	133 (51.8)	
No	352 (57.8)	138 (39.2)	48 (13.6)	165 (46.9)	
LPN/RN coverage on site					.0187
Neither on site	158 (25.9)	71 (44.9)	27 (17.1)	60 (38.0)	
LPN and/or RN <24/7	63 (10.3)	23 (36.5)	6 (9.5)	34 (54.0)	
LPN and/or RN 24/7	388 (63.7)	126 (32.6)	57 (14.7)	204 (52.7)	
Physician (GP) affiliated with site					
No	408 (67.0)	144 (35.3)	67 (16.4)	197 (48.3)	.5031
Yes, office on site	95 (15.6)	34 (35.8)	10 (10.5)	51 (53.7)	
Yes, no office on site	106 (17.4)	42 (40.0)	13 (12.4)	50 (47.6)	
Community size					.0005
<10,000	122 (20.0)	58 (47.5)	12 (9.8)	52 (42.6)	
10,000–99,999	166 (27.3)	68 (41.0)	31 (18.7)	67 (40.4)	
1 million+	321 (52.7)	94 (29.4)	47 (14.7)	179 (55.9)	

DAL, designated assisted living; GP, general practitioner; RHA, regional health authority; SD, standard deviation; 24/7 = 24 hours/day, 7 days/week.
*One resident with other outcomes (censored at date of first discharge from DAL) omitted from comparisons.
†Equivalent level of care = private AL, residential, respite (not in LTC), community support and transition beds; lower level of care = independent living, lodge, condo; higher level of care = LTC (including respite), acute care.

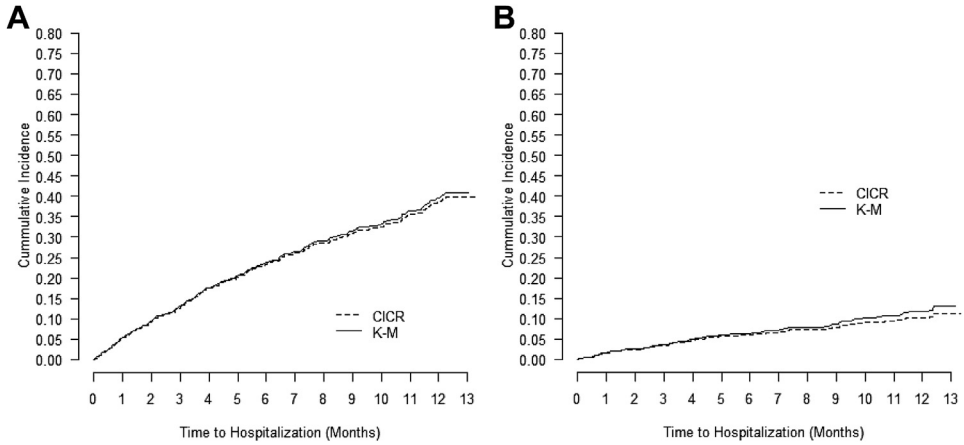

Fig. 1. Cumulative incidence of hospitalization during 1-year follow-up, DAL (A) (n = 609) and LTC (B) (n = 691) dementia cohorts.

Table 3
HRs for Hospitalization During 1-Year Follow-Up, ACCES-DAL Dementia Cohort (n = 609)

Characteristic	HR (95% CIs)		
	Age-Adjusted	Fully Adjusted – 1*	Fully Adjusted – 2†
Age			
65–79, ref gp			
80–85		1.23 (0.81–1.88)	1.22 (0.80–1.86)
86–89		1.07 (0.68–1.66)	1.05 (0.67–1.64)
90+		**1.39 (1.02–1.90)**	**1.39 (1.02–1.89)**
Female	**0.75 (0.56–1.00)**	0.83 (0.59–1.16)	0.84 (0.60–1.19)
Strength of social relationships			
Moderate/high, ref gp			
Low/none	**1.43 (1.13–1.79)**	**1.38 (1.06–1.81)**	**1.38 (1.06–1.81)**
Cognition (CPS score)			
Intact (0), ref gp			
Borderline Intact (1)	**0.44 (0.23–0.87)**	**0.35 (0.18–0.67)**	**0.35 (0.18–0.67)**
Mild Impairment (2)	0.76 (0.46–1.27)	**0.57 (0.35–0.93)**	**0.56 (0.34–0.93)**
Mod-severe–very severe Impairment (3+)	0.72 (0.43–1.19)	**0.54 (0.33–0.89)**	**0.53 (0.32–0.88)**
Activities of daily living (ADL score)			
Independent (0), ref gp			
Supervision required (1)	1.05 (0.72–1.52)	–	–
Limited impairment (2)	1.00 (0.62–1.62)	–	–
Extensive assistance Req'd/dependent (3+)	**1.54 (1.12–2.10)**	–	–
Health instability (CHESS score)			
Stable (0), ref gp			
Mild (1)	**1.51 (1.13–2.01)**	1.28 (0.97–1.70)‡	1.30 (0.99–1.71)‡
Mild-moderate (2)	1.41 (0.97–2.05)‡	1.11 (0.77–1.61)	1.13 (0.79–1.63)
Moderate-high (3+)	**2.45 (1.38–4.35)**	1.34 (0.67–2.71)	1.32 (0.67–2.59)
Fatigue, <3 days			
None (0), ref gp			
Minimal (1)	**1.40 (1.02–1.90)**	1.28 (0.91–1.82)	1.35 (0.98–1.86)‡
Moderate-severe (2+)	**1.99 (1.34–2.96)**	**1.65 (1.03–2.63)**	**1.74 (1.12–2.69)**
Primary mode locomotion			
Walks independently, ref gp			
Walks with device	**1.55 (1.09–2.20)**	–	–
Wheelchair/scooter	**2.01 (1.25–3.23)**	–	–
Falls			
1+ falls/90 days	**1.58 (1.24–2.01)**	–	–
Number of chronic conditions			
0–3, ref gp			
4–5	1.30 (0.92–1.82)	1.07 (0.71–1.62)	–
6+	**1.89 (1.40–2.56)**	1.30 (0.84–2.00)	–
Number of medications			
0–6, ref gp			
7–8	**1.41 (1.01–1.97)**	1.28 (0.92–1.78)	1.35 (0.98–1.86)‡
9–10	**1.52 (1.03–2.24)**	1.27 (0.81–2.00)	1.38 (0.94–2.03)‡
11+	**2.14 (1.51–3.02)**	**1.57 (1.05–2.34)**	**1.72 (1.14–2.59)**
Previous inpatient hospitalizations <1 year			
0, ref gp			
1	1.30 (0.95–1.79)‡	1.09 (0.78–1.53)	1.10 (0.80–1.53)
2+	**2.74 (1.95–3.86)**	**2.28 (1.52–3.42)**	**2.31 (1.54–3.47)**
Bowel incontinence			
Any incontinence	**1.55 (1.18–2.02)**	1.35 (1.00–1.82)‡	1.34 (0.99–1.81)‡
System/facility factors			
Region			
1 (urban), ref gp			
2 (mixed urban/rural)	1.32 (0.86–2.02)	0.84 (0.55–1.26)	0.88 (0.59–1.31)
3 (rural)	**2.51 (1.55–4.08)**	**1.90 (1.10–3.30)**	**2.01 (1.20–3.38)**
4 (urban)	1.15 (0.73–1.81)	1.02 (0.67–1.55)	1.03 (0.69–1.53)
5 (rural)	**1.83 (1.02–3.28)**	1.61 (0.93–2.80)‡	1.62 (0.95–2.76)‡
Community size			
<10,000, ref gp			
10,000–99,999	0.86 (0.58–1.26)	–	–
1 million+	**0.51 (0.35–0.75)**	–	–

ADL, Activities of Daily Living Self–Performance Hierarchy Scale; CHESS, Changes in Health, End-Stage Disease and Symptoms and Signs Scale; DAL, designated assisted living; HR, hazard ratio; ref gp, reference group.
Bold values are statistically significant ($P < .05$).
*Model 1 derived from Cox proportional hazards regression models (first event analysis), with adjustment for clustering by facility, includes number of chronic conditions.
†Model 2 derived from Cox proportional hazards regression models (first event analysis), with adjustment for clustering by facility, excludes number of chronic conditions.
‡$P < .10$.

Discussion

The extent and adverse consequences of acute care admissions for older adults with dementia have been well documented.[18,28,41–47] Yet, research is scarce regarding the impact of different models of care (including organizational, staffing, and service characteristics) on risk of hospitalization among vulnerable populations with dementia.[9,17] In our investigation of diverse care settings in Alberta, residents with

Table 4
Adjusted HRs for Hospitalization During 1-Year Follow-Up Associated With Selected Facility Factors, ACCES-DAL Dementia Cohort (n = 609)

	Adjusted HR (95% CI)*
Model A†	
Number of DAL spaces	
<20	**1.62 (1.02–2.56)**
20–29	0.94 (0.58–1.55)
30–39	1.02 (0.69–1.49)
40+, ref group	–
Model B†	
Part of chain	
No/RHA-operated	1.63 (0.93–2.83)‡
Yes–AL chain	1.24 (0.94–1.64)
Yes–AL/LTC chain, ref group	–

CI, confidence interval; DAL, designated assisted living; HR, hazard ratio; RHA, regional health authority.
Bold values are statistically significant ($P < .05$).
*Derived from Cox proportional hazards regression models (first event analysis), with adjustment for clustering by facility.
†Models were adjusted for age, sex, strength of social relationships, cognition, health instability, fatigue, comorbidity, number of medications, previous hospitalizations, bowel incontinence, and region.
‡$P < .10$.

dementia receiving care in DAL facilities showed a cumulative incidence of hospitalization almost 4 times higher than those in LTC (38.6% vs 10.3% over 12 months). The length of hospital stay and use of ALC bed days was also significantly higher among DAL residents compared with those in LTC.

Our findings are consistent with American studies,[38,40] including the US Collaborative Studies for Long-Term Care,[9] which also showed higher hospitalization rates for residents with dementia in AL relative to LTC. Although direct comparisons are difficult across methodologically diverse studies, previously reported hospitalization rates for community- and clinic-based samples with dementia[28,61] are generally lower than rates among residents with dementia in AL but higher than rates reported among those in LTC facilities.

The lower rate of hospitalization evident among LTC residents with dementia, despite their overall poorer baseline health and functional status (Supplementary Appendix 1), raises a number of important clinical and policy questions. A lower probability of hospitalization for older adults with dementia in nursing homes (eg, compared with those in the community) has been reported elsewhere.[18,62,63] This may reflect changing goals of care (eg, in response to progression of the dementia) as well as service substitution by LTC. Our findings[27] and those from the US[7,9,37] suggest that the AL model may have a limited capacity to care for medically complex residents with dementia.

Advance care planning was also more likely to be in place and adhered to within LTC compared with DAL. The relevance of advance directives in reducing potentially avoidable hospitalizations was recently demonstrated in the CASCADE prospective cohort study of nursing home residents with advanced dementia,[30] which showed that the absence of a "Do Not Hospitalize" order was the most important (and only modifiable) factor associated with hospitalization for acute illness.

We previously showed that DAL residents with a diagnosis of dementia were significantly more likely to be admitted to a LTC facility[12] but no more likely than residents without dementia to be hospitalized.[27] This is in line with reports illustrating a less pronounced impact of dementia on hospitalization among older populations with greater levels of co-morbidity.[41] Findings of the current study suggest that particular sub-groups of DAL residents with dementia (including those aged 90+ years, with poor social relationships, moderate to severe fatigue, health instability, high medication use, and 2+ recent hospitalizations) are at greater risk for admission to an acute care hospital. Not surprisingly, the relative magnitude of risk associated with selected clinical factors (many of which were correlated with previous hospitalizations) was greater in the age-adjusted models. Increased age, higher levels of fatigue and health instability, and 2+ previous hospitalizations likely indicate greater frailty and/or predisposition to being hospitalized.[18,64] These characteristics could be used to define at risk target groups for interventions.

For vulnerable older AL residents with dementia, it may be important to consider end-of life care priorities including enhanced access to palliative care.[34] Preliminary data suggest that increasing the availability of palliative care services within the AL sector may significantly reduce the likelihood of hospitalization and LTC admissions.[38]

While the relationship between medication use and hospitalization risk may reflect the number of drugs acting as a marker of co-morbidity and/or illness severity, many hospital admissions of older individuals are drug-related.[65] Optimizing medication prescription and administration in AL, particularly for frail residents with self-care and/or communication difficulties, have been highlighted as key areas requiring improvement.[5,10,24,66,67]

The finding of a significant independent association between poor social relationships and/or engagement and increased hospitalization risk among DAL residents with dementia may reflect the importance of close social ties in slowing symptom progression in dementia.[68] Higher levels of participation (in group and/or solitary activities) have also been associated with a longer time to discharge from AL.[12,69] Although the mechanisms remain unclear, the potential for interventions aimed at increasing staff awareness of social vulnerability and opportunities for resident engagement to reduce adverse care transitions represent important areas for future research.

The higher hospitalization risk observed for the small number of DAL dementia residents with a CPS score of 0 (relatively intact) may be due to an increased likelihood for less impaired residents to exhibit clearer illness or symptom presentations (prompting a hospital transfer), a greater hesitancy among facility staff and family members to hospitalize more impaired residents, and/or the presence of other unique characteristics among this subgroup. Those with a CPS score of 0 were generally less impaired on all other health and functional characteristics.

Few studies have investigated the impact of facility-level factors on AL residents' quality of care or health outcomes and findings remain unclear.[9,16,17,40] Residents of facilities with certain characteristics (eg, rural, smaller, not affiliated with a ownership chain of AL and/or LTC facilities) were more likely to be admitted to hospital. Given these facility characteristics are inter-related, it is difficult to delineate the underlying mechanisms associated with these factors. All 3 may be linked to lower levels of clinical oversight and services.[70] DAL facilities from rural regions were also those with lower levels of professional staffing and service availability. Others have shown that a higher proportion of licensed nursing staff hours (whether RN or LPN) or more hours of RN staff time per resident might reduce hospitalization risk in residential care and AL.[16,21] This effect has also been reported to be stronger with increasing dementia case mix.[21] The intensity and skill mix of nursing staff used in AL should be commensurate with the health needs of residents with dementia. Our study suggests that greater access to skilled nursing care may be needed to both monitor for early manifestations of declining health and ensure the capacity to provide additional care on site.

Strengths of our study include the large sample, diverse range of resident- and facility-level characteristics examined, and comprehensive prospective data collection. Some limitations warrant consideration. Approximately 28% and 42% of eligible DAL and LTC

residents were not enrolled, respectively. Although their age and sex distributions were similar to participants, this may limit the generalizability of our findings. Our study was restricted to residents of publicly subsidized AL spaces in Alberta. These settings are subject to provincial care standards with admission through a single point of entry. Caution is warranted in generalizing our results to private-pay institutions or to AL facilities elsewhere. Our data do not permit any clear interpretation of the importance of specific care practices or services (present or absent in a facility) to residents' risk of hospitalization. We also did not have access to comparable data on hospitalization rates for older adults with dementia receiving care in their own homes. Finally, the data collection took place between 2006 and 2009. Since then, changes have taken place within the Alberta AL sector, and their possible effect on hospitalization is unknown.

Conclusions

Nearly 40% of DAL residents with dementia in Alberta were hospitalized over a year, a rate substantially higher than that observed for dementia residents in LTC. Many of the resident and facility level factors predictive of hospitalization parallel those reported for nursing homes[29–36,71] suggesting similar opportunities for targeting and/or developing interventions to reduce potentially inappropriate care transitions.[18,19,39,72,73] Although we believe that a proportion of the hospital admissions for DAL residents with dementia are potentially preventable, it is important to note that not all of these hospitalizations are inappropriate. As noted for the nursing home sector,[29] further research in AL[39,74] is required to better define strategies to prevent potentially inappropriate hospitalizations among this vulnerable population.

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Supplementary Data

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